WHAT IS CLAIMED IS:

1. A sub-harmonic generator, comprising:

an input filter operable to receive an input signal containing frequencies from among a first range and to produce a first intermediate signal containing frequencies from among a second range;

a signal divider circuit operable to receive the first intermediate signal and to produce a square wave signal containing square wave signal components at fundamental frequencies from among a third range, the third range of frequencies being about one octave below the second range of frequencies;

a wave-shaping circuit operable to receive the square wave signal and to produce a second intermediate signal containing sinusoidal signal components from among frequencies corresponding to the respective fundamental frequencies of the square wave signal components;

an RMS detector operable to produce an RMS signal corresponding to an instantaneous amplitude of the first intermediate signal; and

a voltage controlled amplifier operable to amplify the second intermediate signal by an amount proportional to the RMS signal to produce a sub-harmonic signal.

2. The sub-harmonic generator of claim 1, further comprising a summing circuit operable to receive a stereo signal including a left channel signal and a right channel signal, and to aggregate the left and right channel signals to produce the input signal.

3. The sub-harmonic generator of claim 1, wherein the input filter is a band-pass filter.

4. The sub-harmonic generator of claim 3, wherein the band-pass filter includes a low pass filter having a first corner

frequency and a high pass filter having a second corner frequency, the first corner frequency being greater than the second corner frequency.

5. The sub-harmonic generator of claim 4, wherein the low pass filter is operable to receive the input signal and to produce a low pass signal, and the high pass filter is operable to receive the low pass signal and to produce the first intermediate signal.

6. The sub-harmonic generator of claim 3, wherein the band-pass filter is operable to pass frequencies in the second range, the second range being contained within the first range.

7. The sub-harmonic generator of claim 6, wherein the band-pass filter includes a low corner frequency of about 40 Hz and a high corner frequency of about 110 Hz such that the second range is about 40-110 Hz.

8. The sub-harmonic generator of claim 6, wherein the band-pass filter includes a low corner frequency of about 56 Hz and a high corner frequency of about 96 Hz such that the second range is about 56-96 Hz.

9. The sub-harmonic generator of claim 1, wherein the signal divider circuit includes a zero crossing detector operable to produce a zero crossing signal that transitions each time the first intermediate signal substantially matches a reference potential.

10. The sub-harmonic generator of claim 9, wherein the zero crossing detector includes a comparator circuit operable to compare respective amplitudes of the reference potential and the first intermediate signal, and to cause the zero crossing signal to transition each time the amplitude of the reference potential

substantially equals the first intermediate signal, the comparator circuit including a hysteresis circuit operable to adjust the amplitude of the reference potential each time the zero crossing signal transitions.

11. The sub-harmonic generator of claim 9, wherein the signal divider circuit further includes a frequency divider circuit operable to receive the zero crossing signal and to produce the square wave signal such that it transitions one time each time the zero crossing signal transitions two times.

12. The sub-harmonic generator of claim 11, wherein the square wave signal transitions between two substantially fixed voltage levels.

13. The sub-harmonic generator of claim 11, wherein the frequency divider includes one of an edge sensitive flip-flop circuit and a level sensitive flip-flop circuit, the flip-flop circuit being operable to receive the zero crossing signal and to produce the square wave signal such that it transitions one time each time the zero crossing signal transitions two times.

14. The sub-harmonic generator of claim 11, wherein the third range of frequencies is about 20 Hz to about 55 Hz.

15. The sub-harmonic generator of claim 11, wherein the third range of frequencies is about 28 Hz to about 48 Hz.

16. The sub-harmonic generator of claim 1, wherein the wave-shaping circuit includes at least one band-pass filter operable to receive the square wave signal and to attenuate frequencies substantially outside the third range such that the second intermediate signal contains the sinusoidal signal components at frequencies corresponding to the respective fundamental frequencies of the square wave signal components.

17. The sub-harmonic generator of claim 16, wherein the wave-shaping circuit includes a plurality of band-pass filters, each receiving the square wave signal and having a respective center frequency such that a sum of outputs of the band-pass filters substantially exclude frequencies outside the third range.

18. The sub-harmonic generator of claim 17, wherein the wave-shaping circuit includes first and second band-pass filters, the first band-pass filter having a center frequency within about 25 to about 35 Hz and the second band-pass filter having a center frequency within about 40 Hz to about 50 Hz.

19. The sub-harmonic generator of claim 18, wherein the first band-pass filter has a Q-factor within about 3.0 to about 3.5 and the second band-pass filter has a Q-factor within about 3.5 to about 4.5.

20. The sub-harmonic generator of claim 16, wherein the at least one band-pass filter includes a selectable center frequency such that the attenuated frequencies substantially outside the third range are adjustable.

21. The sub-harmonic generator of claim 1, further comprising:

at least one band-pass filter operable to receive the input signal and to produce a third intermediate signal containing frequencies from among a fourth range, the fourth range of frequencies including at least some frequencies above the third range of frequencies;

an amplifier operable to increase an amplitude of the third intermediate signal to produce a fourth intermediate signal; and

a summation circuit operable to sum the sub-harmonic signal and the fourth intermediate signal to produce at least a portion of an output signal.

22. The sub-harmonic generator of claim 21, wherein the at least one band-pass filter includes first, second and third band-pass filters such that a sum of outputs of the first, second, and third band-pass filters exclude frequencies substantially outside the fourth range, the first band-pass filter having a center frequency within about 35 Hz to about 45 Hz, the second band-pass filter having a center frequency within about 55 Hz to about 65 Hz, and the third band-pass filter having a center frequency within about 95 Hz to about 105 Hz.

23. The sub-harmonic generator of claim 22, wherein the first band-pass filter has a center frequency of about 40 Hz, the second band-pass filter has a center frequency of about 58 Hz, and the third band-pass filter has a center frequency of about 98 Hz.

24. The sub-harmonic generator of claim 23, wherein the first band-pass filter has a Q-factor within about 1.5 to about 2.0, the second band-pass filter has a Q-factor within about 1.75 to about 2.25, and the third band-pass filter has a Q-factor within about 1.75 to about 2.25.

25. The sub-harmonic generator of claim 21, further comprising an adjustment control operable to vary the magnitude of the third intermediate signal.

26. The sub-harmonic generator of claim 21, further comprising a low pass filter operable to (i) receive the sub-harmonic signal; and (ii) attenuate frequencies substantially below the third range to produce a filtered sub-harmonic signal, the summation circuit being further operable to sum the filtered

sub-harmonic signal and the fourth intermediate signal to produce at least a portion of the output signal.

27. The sub-harmonic generator of claim 5, further comprising:

at least one further band-pass filter operable to receive the input signal and to produce a third intermediate signal containing frequencies from among a fourth range, the fourth range of frequencies including at least some frequencies above the third range of frequencies;

an amplifier operable to increase an amplitude of the third intermediate signal to produce a fourth intermediate signal; and

a summation circuit operable to sum (i) the sub-harmonic signal; (ii) the fourth intermediate signal; and (iii) the low pass signal to produce at least a portion of the output signal.

28. The sub-harmonic generator of claim 2, further comprising:

at least one band-pass filter operable to receive the input signal and to produce a third intermediate signal containing frequencies from among a fourth range, the fourth range of frequencies including at least some frequencies above the third range of frequencies;

an amplifier operable to increase an amplitude of the third intermediate signal to produce a fourth intermediate signal;

a left channel summation circuit operable to sum the left channel signal and the fourth intermediate signal to produce at least a portion of a left channel output signal; and

a right channel summation circuit operable to sum the right channel signal and the fourth intermediate signal to produce at least a portion of a right channel output signal.

29. The sub-harmonic generator of claim 2, further comprising stereo width expansion circuit operable to (i) cancel energy at at least some frequencies from among a fourth range of

frequencies from the left channel signal to produce at least a portion of a left channel output signal; and (ii) cancel energy at at least some frequencies from among a fifth range of frequencies from the right channel signal to produce at least a portion of a right channel output signal.

30. The sub-harmonic generator of claim 29, wherein the stereo width expansion circuit includes:

a left channel band-pass filter having a center frequency at about a mid-frequency of the fifth range of frequencies, the left channel band-pass filter being operable to produce an inverted left channel signal containing a band of frequencies from among the fifth range of frequencies;

a right channel band-pass filter having a center frequency at about a mid-frequency of the fourth range of frequencies, the right channel band-pass filter being operable to produce an inverted right channel signal containing a band of frequencies from among the fourth range of frequencies;

a left channel summation circuit operable to sum at least the left channel signal and the inverted right channel signal to produce at least a portion of the left channel output signal; and

a right channel summation circuit operable to sum at least the right channel signal and the inverted left channel signal to produce at least a portion of the right channel output signal.

31. The sub-harmonic generator of claim 30, wherein:

the inverted left channel signal has frequency, amplitude and phase characteristics such that energy of the right channel signal at frequencies from among the fifth range of frequencies are substantially attenuated when the right channel signal and the inverted left channel signal are summed to produce at least a portion of the right channel output signal; and

the inverted right channel signal has frequency, amplitude and phase characteristics such that energy of the left channel signal at frequencies from among the fourth range of frequencies

are substantially attenuated when the left channel signal and the inverted right channel signal are summed to produce at least a portion of the left channel output signal.

32. The sub-harmonic generator of claim 30, wherein a center frequency of one of the left channel band-pass filter and the right channel band-pass filter is within about 175 Hz to about 225 Hz and a center frequency of the other of the left channel band-pass filter and the right channel band-pass filter is within about 150 Hz to about 200 Hz.

33. The sub-harmonic generator of claim 30, wherein a center frequency of one of the left channel band-pass filter and the right channel band-pass filter is about 200 Hz and a center frequency of the other of the left channel band-pass filter and the right channel band-pass filter is about 175 Hz.

34. The sub-harmonic generator of claim 30, wherein:
the stereo width expansion circuit further includes a left channel high-pass filter operable receive the left channel signal and to produce a left channel high pass signal containing frequencies from among those at or above a first corner frequency, and a right channel high-pass filter operable to receive the right channel signal and to produce a right channel high pass signal containing frequencies from among those at or above a second corner frequency;

the left channel summation circuit is further operable to sum at least the left channel signal, the inverted right channel signal, and the left channel high pass signal to produce at least a portion of the left channel output signal; and

the right channel summation circuit is further operable to sum at least the right channel signal, the inverted left channel signal, and the right channel high pass signal to produce at least a portion of the right channel output signal.

35. The sub-harmonic generator of claim 34, wherein the left channel high-pass filter is further operable to amplify energy of the left channel signal at or above the first corner frequency to produce the left channel high pass signal; and the right channel high-pass filter is further operable to amplify energy of the right channel signal at or above the second corner frequency to produce the right channel high pass signal.

36. The sub-harmonic generator of claim 34, wherein:

the left channel summation circuit includes (i) a first summation circuit operable to sum at least the left channel high pass signal and the inverted right channel signal to produce a left expansion signal, and (ii) a second summation circuit operable to sum at least the left channel signal and the left expansion signal to produce at least a portion of the left channel output signal; and

the right channel summation circuit includes (i) a first summation circuit operable to sum at least the right channel high pass signal and the inverted left channel signal to produce a right expansion signal, and (ii) a second summation circuit operable to sum at least the right channel signal and the right expansion signal to produce at least a portion of the right channel output signal.

37. The sub-harmonic generator of claim 36, wherein the stereo width expansion circuit further includes a left channel adjustment control operable to vary a magnitude of the left expansion signal and a right channel adjustment control operable to vary a magnitude of the right expansion signal.

38. A sub-harmonic generator, comprising:

a sub-harmonic signal circuit operable to (i) receive an input signal containing frequencies from among a first range, (ii) filter the input signal to produce a first intermediate signal containing frequencies from among a second range, and

(iii) produce a sub-harmonic signal from the first intermediate signal containing frequencies from among a third range, the third range of frequencies being about one octave below the second range of frequencies;

at least one band-pass filter operable to receive the input signal and to produce a second intermediate signal containing frequencies from among a fourth range, the fourth range of frequencies including at least some frequencies above the third range of frequencies;

an amplifier operable to increase an amplitude of the second intermediate signal to produce a third intermediate signal; and

a summation circuit operable to sum the sub-harmonic signal and the third intermediate signal to produce at least a portion of an output signal.

39. The sub-harmonic generator of claim 38, wherein the at least one band-pass filter includes first, second and third band-pass filters such that a sum of outputs of the first, second, and third band-pass filters exclude frequencies substantially outside the fourth range, the first band-pass filter having a center frequency within about 35 Hz to about 45 Hz, the second band-pass filter having a center frequency within about 55 Hz to about 65 Hz, and the third band-pass filter having a center frequency within about 95 Hz to about 105 Hz.

40. The sub-harmonic generator of claim 39, wherein the first band-pass filter has a center frequency of about 40 Hz, the second band-pass filter has a center frequency of about 58 Hz, and the third band-pass filter has a center frequency of about 98 Hz.

41. The sub-harmonic generator of claim 40, wherein the first band-pass filter has a Q-factor within about 1.5 to about 2.0, the second band-pass filter has a Q-factor within about 1.75

to about 2.25, and the third band-pass filter has a Q-factor within about 1.75 to about 2.25.

42. The sub-harmonic generator of claim 38, further comprising a user adjustment control operable to vary the magnitude of the second intermediate signal.

43. The sub-harmonic generator of claim 38, further comprising a low pass filter operable to (i) receive the sub-harmonic signal; and (ii) attenuate frequencies substantially below the third range to produce a filtered sub-harmonic signal, the summation circuit being further operable to sum the filtered sub-harmonic signal and the third intermediate signal to produce at least a portion of the output signal.

44. The sub-harmonic generator of claim 38, wherein the sub-harmonic circuit is further operable to produce a low pass signal containing frequencies from among those below a first corner frequency, and the summation circuit being further operable to sum (i) the sub-harmonic signal; (ii) the third intermediate signal; and (iii) the low pass signal to produce at least a portion of the output signal.

45. The sub-harmonic generator of claim 38, further comprising:

a summing circuit operable to receive a stereo signal including a left channel signal and a right channel signal, and to aggregate the left and right channel signals to produce the input signal;

a left channel summation circuit operable to sum the left channel signal and the third intermediate signal to produce at least a portion of a left channel output signal; and

a right channel summation circuit operable to sum the right channel signal and the third intermediate signal to produce at least a portion of a right channel output signal.

46. The sub-harmonic generator of claim 45, further comprising stereo width expansion circuit operable to (i) cancel energy at at least some frequencies from among a fifth range of frequencies from the left channel signal to produce at least a portion of the left channel output signal; and (ii) cancel energy at at least some frequencies from among a sixth range of frequencies from the right channel signal to produce at least a portion of the right channel output signal.

47. The sub-harmonic generator of claim 46, wherein the stereo width expansion circuit includes:

a left channel band-pass filter having a center frequency at about a mid-frequency of the sixth range of frequencies, the left channel band-pass filter being operable to produce an inverted left channel signal containing a band of frequencies from among the sixth range of frequencies;

a right channel band-pass filter having a center frequency at about a mid-frequency of the fifth range of frequencies, the right channel band-pass filter being operable to produce an inverted right channel signal containing a band of frequencies from among the fifth range of frequencies;

a left channel summation circuit operable to sum at least the left channel signal and the inverted right channel signal to produce at least a portion of the left channel output signal; and

a right channel summation circuit operable to sum at least the right channel signal and the inverted left channel signal to produce at least a portion of the right channel output signal.

48. The sub-harmonic generator of claim 47, wherein:

the inverted left channel signal has frequency, amplitude and phase characteristics such that energy of the right channel signal at frequencies from among the sixth range of frequencies are substantially attenuated when the right channel signal and the inverted left channel signal are summed to produce at least a portion of the right channel output signal; and

the inverted right channel signal has frequency, amplitude and phase characteristics such that energy of the left channel signal at frequencies from among the fifth range of frequencies are substantially attenuated when the left channel signal and the inverted right channel signal are summed to produce at least a portion of the left channel output signal.

49. The sub-harmonic generator of claim 47, wherein a center frequency of one of the left channel band-pass filter and the right channel band-pass filter is within about 175 Hz to about 225 Hz and a center frequency of the other of the left channel band-pass filter and the right channel band-pass filter is within about 150 Hz to about 200 Hz.

50. The sub-harmonic generator of claim 47, wherein a center frequency of one of the left channel band-pass filter and the right channel band-pass filter is about 200 Hz and a center frequency of the other of the left channel band-pass filter and the right channel band-pass filter is about 175 Hz.

51. The sub-harmonic generator of claim 47, wherein:

the stereo width expansion circuit further includes a left channel high-pass filter operable receive the left channel signal and to produce a left channel high pass signal containing frequencies from among those at or above a first corner frequency, and a right channel high-pass filter operable to receive the right channel signal and to produce a right channel high pass signal containing frequencies from among those at or above a second corner frequency;

the left channel summation circuit is further operable to sum at least the left channel signal, the inverted right channel signal, and the left channel high pass signal to produce at least a portion of the left channel output signal; and

the right channel summation circuit is further operable to sum at least the right channel signal, the inverted left channel

signal, and the right channel high pass signal to produce at least a portion of the right channel output signal.

52. The sub-harmonic generator of claim 51, wherein

the left channel high-pass filter is further operable to amplify energy of the left channel signal at or above the first corner frequency to produce the left channel high pass signal; and

the right channel high-pass filter is further operable to amplify energy of the right channel signal at or above the second corner frequency to produce the right channel high pass signal.

53. The sub-harmonic generator of claim 51, wherein:

the left channel summation circuit includes (i) a first summation circuit operable to sum at least the left channel high pass signal and the inverted right channel signal to produce a left expansion signal, and (ii) a second summation circuit operable to sum at least the left channel signal and the left expansion signal to produce at least a portion of the left channel output signal; and

the right channel summation circuit includes (i) a first summation circuit operable to sum at least the right channel high pass signal and the inverted left channel signal to produce a right expansion signal, and (ii) a second summation circuit operable to sum at least the right channel signal and the right expansion signal to produce at least a portion of the right channel output signal.

54. The sub-harmonic generator of claim 53, wherein the stereo width expansion circuit further includes a left channel adjustment control operable to vary a magnitude of the left expansion signal and a right channel adjustment control operable to vary a magnitude of the right expansion signal.

55. An expansion circuit for increasing an apparent stereo width produced by a left channel signal and a right channel signal, comprising:

a left channel circuit operable to cancel energy at at least some frequencies from among a first range of frequencies from the left channel signal to produce at least a portion of a left channel output signal, the at least some frequencies from among the first range of frequencies being derived from the right channel signal; and

a right channel circuit operable to cancel energy at at least some frequencies from among a second range of frequencies from the right channel signal to produce at least a portion of a right channel output signal, the at least some frequencies from among the second range of frequencies being derived from the left channel signal.

56. The expansion circuit of claim 55, wherein:

the left channel circuit includes a left channel band-pass filter having a center frequency at about a mid-frequency of the second range of frequencies, the left channel band-pass filter being operable to produce an inverted left channel signal containing a band of frequencies from among the second range of frequencies;

the right channel circuit includes a right channel band-pass filter having a center frequency at about a mid-frequency of the first range of frequencies, the right channel band-pass filter being operable to produce an inverted right channel signal containing a band of frequencies from among the first range of frequencies;

the left channel circuit further includes a left channel summation circuit operable to sum at least the left channel signal and the inverted right channel signal to produce at least a portion of the left channel output signal; and

the right channel circuit further includes a right channel summation circuit operable to sum at least the right channel

signal and the inverted left channel signal to produce at least a portion of the right channel output signal.

57. The expansion circuit of claim 56, wherein:

the inverted left channel signal has frequency, amplitude and phase characteristics such that energy of the right channel signal at frequencies from among the second range of frequencies are substantially attenuated when the right channel signal and the inverted left channel signal are summed to produce at least a portion of the right channel output signal; and

the inverted right channel signal has frequency, amplitude and phase characteristics such that energy of the left channel signal at frequencies from among the first range of frequencies are substantially attenuated when the left channel signal and the inverted right channel signal are summed to produce at least a portion of the left channel output signal.

58. The expansion circuit of claim 56, wherein a center frequency of one of the left channel band-pass filter and the right channel band-pass filter is within about 175 Hz to about 225 Hz and a center frequency of the other of the left channel band-pass filter and the right channel band-pass filter is within about 150 Hz to about 200 Hz.

59. The expansion circuit of claim 56, wherein a center frequency of one of the left channel band-pass filter and the right channel band-pass filter is about 200 Hz and a center frequency of the other of the left channel band-pass filter and the right channel band-pass filter is about 175 Hz.

60. The expansion circuit of claim 56, wherein:

the left channel circuit further includes a left channel high-pass filter operable receive the left channel signal and to produce a left channel high pass signal containing frequencies from among those at or above a first corner frequency;

the right channel circuit further includes a right channel high-pass filter operable to receive the right channel signal and to produce a right channel high pass signal containing frequencies from among those at or above a second corner frequency;

the left channel summation circuit is further operable to sum at least the left channel signal, the inverted right channel signal, and the left channel high pass signal to produce at least a portion of the left channel output signal; and

the right channel summation circuit is further operable to sum at least the right channel signal, the inverted left channel signal, and the right channel high pass signal to produce at least a portion of the right channel output signal.

61. The expansion circuit of claim 60, wherein

the left channel high-pass filter is further operable to amplify energy of the left channel signal at or above the first corner frequency to produce the left channel high pass signal; and

the right channel high-pass filter is further operable to amplify energy of the right channel signal at or above the second corner frequency to produce the right channel high pass signal.

62. The expansion circuit of claim 60, wherein:

the left channel summation circuit includes (i) a first summation circuit operable to sum at least the left channel high pass signal and the inverted right channel signal to produce a left expansion signal, and (ii) a second summation circuit operable to sum at least the left channel signal and the left expansion signal to produce at least a portion of the left channel output signal; and

the right channel summation circuit includes (i) a first summation circuit operable to sum at least the right channel high pass signal and the inverted left channel signal to produce a right expansion signal, and (ii) a second summation circuit operable to sum at least the right channel signal and the right

expansion signal to produce at least a portion of the right channel output signal.

63. The expansion circuit of claim 62, wherein the stereo width expansion circuit further includes a left channel adjustment control operable to vary a magnitude of the left expansion signal and a right channel adjustment control operable to vary a magnitude of the right expansion signal.

64. The expansion circuit of claim 60, wherein the first corner frequency is about 5.3 KHz.

65. The expansion circuit of claim 60, wherein the first and second corner frequencies are about 5.3 KHz.